B.C. HYDRO

WESTERN LNG PROJECT ELECTRICAL SUPPLY:

THE RUPERT-GRASSY POINT TRANSMISSION LINE

PLANNING REPORT

A Report To Dome Petroleum Limited

SE 8313

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1 INTRODUCTION

Dome Petroleum Limited (Dome) requires an electrical supply of about 150,000 kilowatts at a load factor of about 90 percent in order to operate its Western LNG Project. B.C. Hydro proposes to supply this electricity by means of a single circuit 230 kV or 287 kV 3-phase, 60 hertz transmission line between B.C. Hydro's existing Rupert Substation, located on the south end of Morse Basin adjacent to Highway 16, and substation facilities to be constructed by Dome within the LNG plant limits at Grassy Point. Figure 1 shows the general project area and the general routes for the proposed pipeline and road on the Tsimpsean Peninsula. Figure 2 shows the possible transmission line routes.

This report describes the proposed Rupert-Grassy Point transmission line, summarizes B.C. Hydro's transmission line planning studies, and recommends a transmission route across the Tsimpsean Peninsula to Grassy Point. This report is based upon common corridor planning with Westcoast Transmission Company Limited (Westcoast) and with Dome, and upon system planning studies, project cost estimates, and socio-economic and environmental impact assessment studies conducted between August 1982 and March 1983.

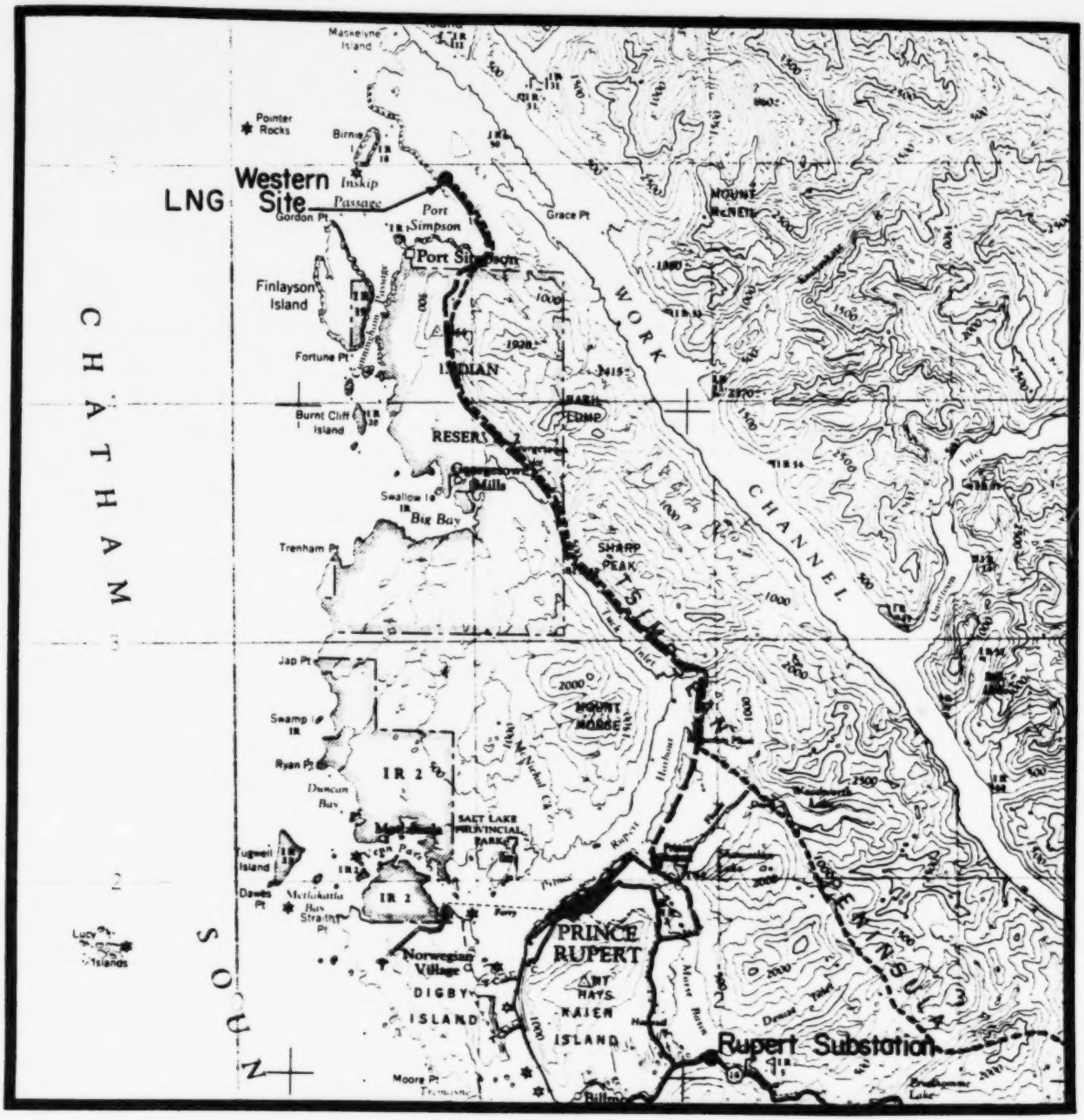


FIGURE 1 : PROJECT AREA

——— Proposed Road

------- Proposed Pipeline

Scale : 1 : 250,000

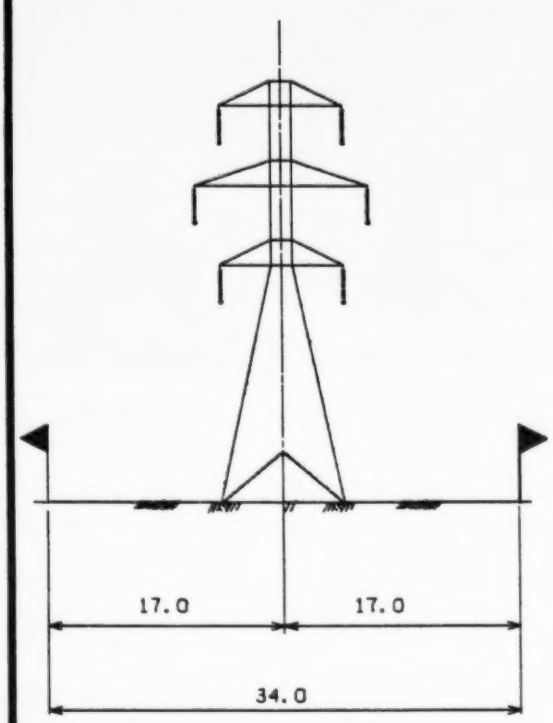
2 PROJECT DESCRIPTION

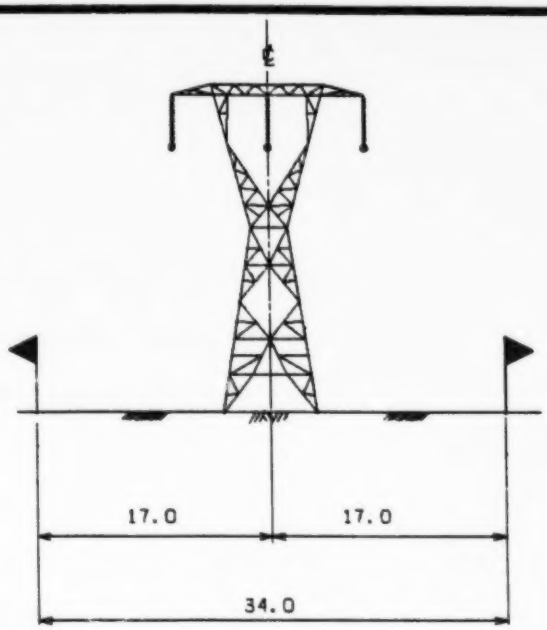
The proposed transmission line will connect B.C. Hydro's existing Rupert Substation with Dome's proposed Grassy Point facility. The operating voltage level will be either 230 kV or 287 kV. Except for the technical electrical considerations discussed below, few differences between the two transmission lines exist. The structures and rights of way required are similar, although those for 287 kV would be somewhat larger than those for 230 kV. Approximate dimensions are shown in Figures 3 and 4.

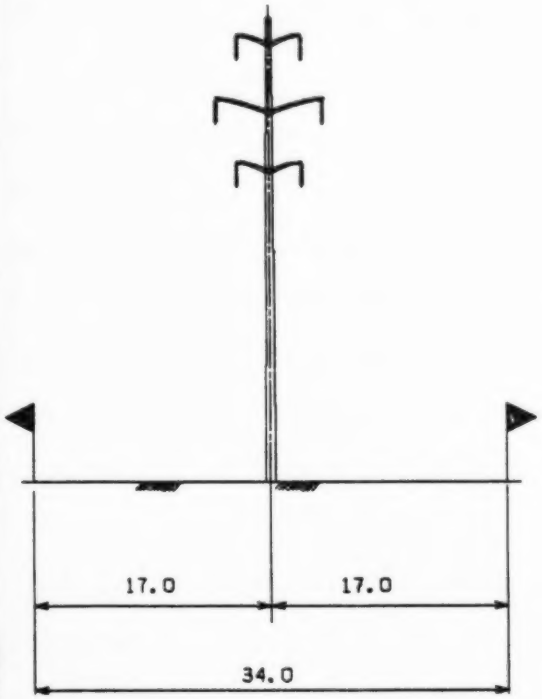
The Rupert-Grassy Point transmission line would be a three phase circuit; i.e., a single set of three conductors or wires through which electrical current flows.

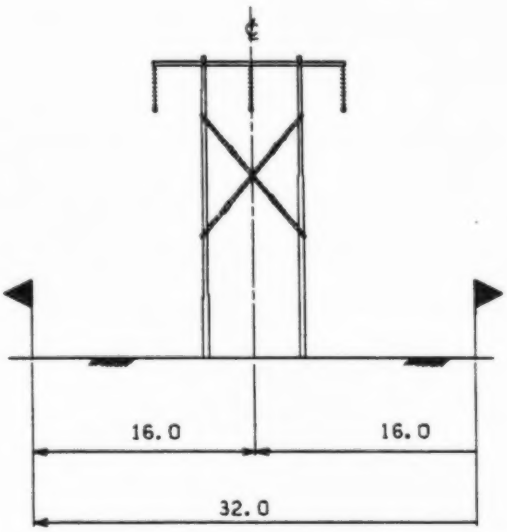
The line length would be between 47.4 km and 52.2 km, depending upon the final route selected. Figure 2, found in the rear pocket, shows the route options considered. Figure 5 lists the route segment lengths.

The legal right of way width requirements are expected to vary between 30 and 40 metres. See Figure 3. These widths depend upon the operating line voltage and span lengths. Clearing widths may be wider or narrower than the width between legal boundaries, depending upon tree heights and side slopes. Trees outside the legal boundaries must be removed if there is a possibility of them falling onto the









NOTES:

1. DIMENSIONS ARE PRELIMINARY ONLY AND MAY VARY ACCORDING TO TERRAIN.
2. ALL DIMENSIONS ARE IN METRES.

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY	
RUPERT - GRASSY POINT HIGH VOLTAGE TRANSMISSION LINE PRELIMINARY RIGHT OF WAY CROSS SECTIONS	
DATE	FIGURE 3
DWN.	DWG. No.

CAD FILE No. (34,2)RUPERTTWR.DGN

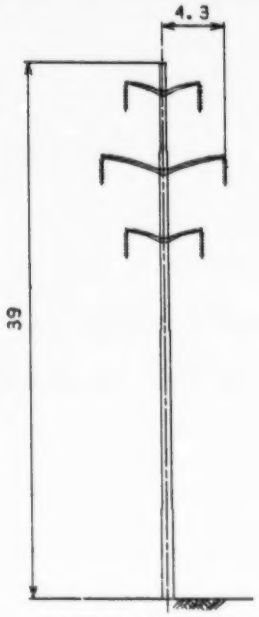
transmission line.

In general, wooden poles about 21 metres high would be used. Average span lengths would be about 250 metres. Span lengths vary considerably depending upon the terrain and individual site requirements.

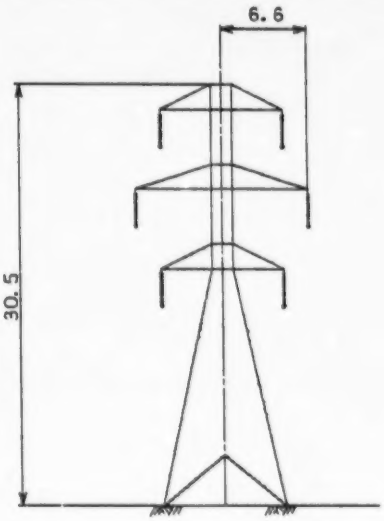
Steel structures would be required where long spans are necessary. In particular, the long water crossing spans in segments A'-B', A'-C and E-F may need steel structures. They would be between 25 and 39 metres high, depending upon the technical requirements. See Figure 4.

In addition, a portion of this line, segment A-A', may be built with the capacity to be converted to a double circuit line, where two sets of conductors hang from the same structure. Between Rupert Substation and Butze Rapids, the use of scarce right of way space would preempt the possibility of routing another transmission line, needed for future local Prince Rupert transmission, across Galloway Rapids and Hospital Cove. In this area, a double circuit steel tower line would be built, although initially only one side would be strung with conductors.

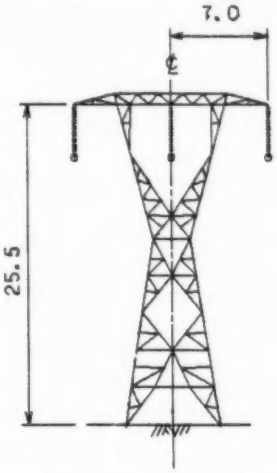
Substation equipment would be accommodated within the existing Rupert Substation boundaries. At the other end, substation facilities would be located on the LNG plant site.



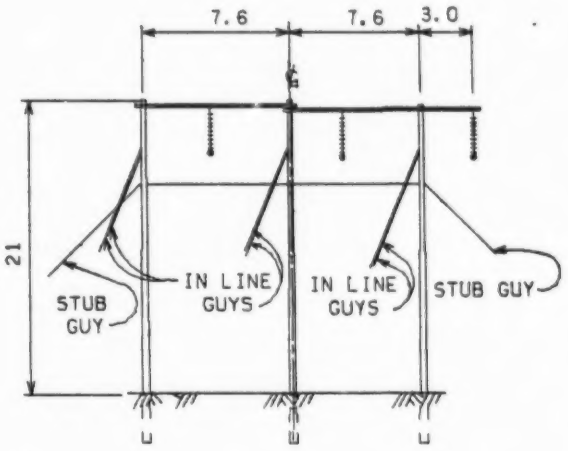
DOUBLE CIRCUIT STEEL POLE



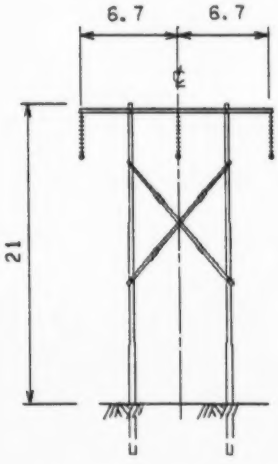
DOUBLE CIRCUIT
LATTICE HEAVY ANGLE TOWER



TANGENT & LIGHT ANGLE
(SELF SUPPORTING TOWER)



DEAD END
(WOOD POLE STRUCTURE)



TANGENT & LIGHT ANGLE
(WOOD POLE STRUCTURE)

NOTES:

1. STRUCTURE HEIGHTS AVERAGE ONLY.
2. ALL DIMENSIONS ARE IN METRES.

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

RUPERT - GRASSY POINT

HIGH VOLTAGE TRANSMISSION LINE

TYPICAL STEEL TOWER AND
WOOD POLE STRUCTURE OUTLINES

DATE	FIGURE 4
DWN.	DWG. No.

CAD FILE No. [34,23]RUPERTTWR.DGN

3 SYSTEM PLANNING STUDIES

In principle, B.C. Hydro can supply the 150,000 kilowatts required for the Western LNG Project without difficulty. The Rupert - Grassy Point transmission line is relatively short and straight forward, at least when viewed alone. However, some system planning concerns are created by the project's large electric demand and its remote location in relation to the provincial system as a whole.

3.1 System Relationships

Port Simpson is situated alone at the end of the Tsimpsean Peninsula; all electrical service must be routed through the Rupert Substation. The Western LNG plant would almost triple the present peak demand in the Prince Rupert area and would influence long range development plans. No opportunities exist for interconnection with other electrical sources.

The Prince Rupert area is presently served by a single 287 kV transmission line from the Skeena Substation near Terrace. However, if the 287 kV line fails, supply to the Prince Rupert area is limited to local generation. By the winter of 1988, residential and commercial loads alone are expected to exceed this local supply. This situation would exist even if the Western LNG Project does not proceed.

3.2 Voltage Options

The nominal voltage levels at Rupert Substation are 12 kV, 25 kV, 69 kV and 287 kV. The 287 kV level is unique to the North Coast Region; 230 kV is the equivalent standard throughout the rest of the province. The 500 kV level will be introduced if a 500 kV line is built between the Skeena Substation and the Rupert Substation as is now planned for 1988.

No decision has been made whether to use 230 kV or 287 kV transmission facilities between Rupert Substation and Grassy Point. The choice of transmission voltage is a system planning issue involving the Rupert-Grassy Point line, long term substation and transmission requirements, and the Skeena-Rupert transmission system. Either voltage would provide adequate capacity to the Western LNG project.

This choice will not influence the common corridor planning process or other aspects of this transmission project. The principal non-electrical differences in the two transmission lines are minor changes in right of way widths and in structure and conductor sizes.

3.2.1 Substation Considerations

A new 287 kV line can be terminated at Rupert Substation without voltage transformation. However, the introduction of 500 kV into Rupert Substation in 1988 would make step down transformation necessary. Then, the standard 230 kV level would become a feasible alternative to 287 kV. During the next thirty years, additional 230 kV or 287 kV stations may be developed in the area. The development of a 230 kV voltage level at Rupert Substation would result in higher station costs there in the early stages, but may be less expensive in the long term.

3.2.2 Transmission Considerations

The land requirements and environmental impacts of 230 kV and 287 kV transmission are similar. Costs for 287 kV construction are expected to be about 20 percent higher than for 230 kV depending on the type of towers used.

Transmission capability at 287 kV is about 50 percent higher than at 230 kV. In general, transmission losses at 287 kV are about half those at 230 kV. For the relatively short Rupert-Grassy Point line, transmission losses would be a relatively minor factor at the 150,000 kilowatt load level with either voltage level.

3.3 The Skeena-Rupert Transmission Line

A 500 kV Skeena-Rupert line is scheduled for 1988, regardless of the Western LNG Project. This line appeared first in B.C. Hydro's system plan in 1978, before the Western LNG Project was included in the load forecast. It will be required in 1988 for power supply security reasons.

Ultimately, two 500 kV lines are anticipated for the Skeena-Rupert transmission system. Introduction of the first 500 kV line could be deferred until about 2000 by building a second 287 kV line. However, this is not long enough to make the use of a 287 kV line more attractive economically than construction of a 500 kV line initially. Any new, large bulk loads in the Prince Rupert area would advance the date that a new 287 kV line built would have to be replaced. Long term economics would be about the same for a 500 kV line built in 1988 as for a 287 kV line constructed in 1988 with the intention of replacing it later. Consequently, a 500 kV line is planned for 1988 with or without the Western LNG Project.

3.4 Local Prince Rupert Transmission Development

Available space is limited for transmission line rights of way on Kaien Island. If the Rupert to Grassy Point line follows the corridor selected for the future local area transmission loop to Oldfield Substation; i.e., from Rupert Substation to Galloway

Rapids and Butze Rapids, then double circuit construction, with only one side strung initially, would be needed.

3.5 Local Electrical Supply to Port Simpson

Port Simpson has a peak demand of about 1,000 kilowatts. The village is supplied by an existing 25 kV transmission line from the Oldfield Substation via Digby Island and Metlakatla. Sufficient capacity is available on this line to supply twice the current peak demand at Port Simpson.

It may be advantageous to extend the 25 kV line from Port Simpson to Grassy Point for use during plant construction instead of on site generation. This would depend upon the nature, size and timing of Dome's construction power requirements before the supply is available from Rupert Substation.

Also, consideration is being given to providing Port Simpson's power supply via a new 25 kV line from Grassy Point rather than the existing line from Oldfield Substation in Prince Rupert. Such an arrangement could improve security, make maintenance easier because of better access and increase available capacity. These benefits may or may not be sufficient to justify the associated substation and distribution construction costs of extending the 25 kV line from Port Simpson to Grassy Point. Of course, these costs would be less, if the 25 kV were built initially for Dome's construction needs.

4 ROUTE SELECTION STUDIES

Preliminary route selection studies were conducted between August 1982 and March 1983. These studies are summarized here.

The engineering studies identified and evaluated technically feasible transmission line corridors using transmission line design, construction, security and cost criteria.

The environmental studies evaluated the potential environmental consequences of constructing a transmission line along these technically feasible corridors and suggested means to minimize potential adverse environmental impacts. In particular, the environmental studies assessed the effects of this project on the terrain, water resources, vegetation, fish, wildlife, land use, agriculture, forestry, mining, visual impact, recreational use, and heritage resources of the Tsimpsean Peninsula.

4.1 Initial Corridor Selection

The feasibility of constructing the transmission line was examined originally in May 1981 at Dome's request. During this brief study, B.C. Hydro studied topographic maps and air photographs and flew over the area in a helicopter in order to assess topography, vegetation, existing land use and access on the Tsimpsean Peninsula.

Initially, all conceivable corridors were inspected. A route continuing up Denise Creek and along the east shore of Work Channel was examined and rejected because of steep slopes and potential land slide activity in the area. Later, for similar reasons, segment E-H up Silver Creek to Work Channel, was eliminated. Those corridors considered feasible were identified for future study. They are shown on Figure 2.

In May 1981, at the feasibility stage, before common corridor opportunities were known, the preferred route was A-B-C-D-E-F-G-H-I. An alternative via Woodworth Lake, A-B-D-E-F-G-H-I, was considered favorably also.

4.2 Common Corridor Considerations

When project planning continued in August 1982, B.C. Hydro learned of Dome's plans to construct an industrial road between Prince Rupert and Grassy Point with a bridge across Morse Basin. Initially, five bridge crossing sites were studied. Crossings at Fern Passage and at Butze Rapids were considered in detail.

Subsequently, the Butze Rapids crossing was chosen. From the eastern shores of Morse Basin at Butze Rapids, this road would proceed to a point opposite Seal Cove, and go northward parallel to the upper Prince Rupert harbor, west of Shawatlan Lake. Then, it would follow along Tuck Inlet, through the Lax Kw'alaams Indian

Reserve #2 to Grassy Point. That road would use essentially the same route as A'-B'-C-D-E-F-G-I.

In addition, Westcoast plans to build a 610 mm (outside diameter) natural gas pipeline to supply the LNG plant from northeastern British Columbia and Alberta. The western end of this pipeline would cross from the vicinity of Prudhomme Lake to Woodworth Lake and join the common utility corridor used by the road and the transmission line at node D. (See Figures 1 and 2.) From there, the pipeline would follow essentially the same route as the road; i.e., D-E-F-G-I.

Route location options on the Tsimpsean Peninsula are limited by topography and access for all three facilities. Not surprisingly, common corridor discussions between the three companies indicate a strong possibility that the road and the transmission line would follow the same basic route from node B' northward and that all three facilities would use substantially the same route north of node D. While they would not be precisely parallel, they would be generally within a common corridor 200 metres wide. In many places, they would be within 100 metres of each other.

Use of the same corridor presents opportunities for cooperative planning in order to minimize surveying, clearing, and construction costs, to decrease land loss, to reduce the number of stream

crossings, and generally to reduce the cumulative environmental impacts on the Tsimpsean Peninsula.

B.C. Hydro assumed that the transmission line would go around Morse Basin along route A-B-B'-C-D or A-B-D in order to avoid crossing Morse Basin at Fern Passage or at Butze Rapids. Previously, B.C. Hydro had studied crossings there for a proposed 287 kV transmission line from Rupert Substation to Oldfield Substation. However, Transport Canada and the seaplane operators at Seal Cove opposed these crossings due to aviation hazards and the existence of other route alternatives.

However, the presence of the bridge across Morse Basin caused B.C. Hydro to reassess its preliminary conclusions reached the previous year. If the transmission line could be placed adjacent to the new bridge, the relative consequences of the line itself would be less. Accordingly, B.C. Hydro added routes A-A'-B'-C and A-A'-C to its route location study.

Similarly, B.C. Hydro intended to avoid crossing the Indian reserve; i.e., to use route G-H-I. However, the common corridor planning process, the use of reserve land by the road and the pipeline, and Dome's negotiations with the Lax Kw'alaams Band made use of route G-I feasible.

B.C. Hydro planned originally to use segment F-G east. But it

was unknown whether enough space exists on the east side of Tuck Inlet to accommodate all three facilities. Therefore, segment F-G west was added in the second phase of the route location study in case the transmission line was required to be on the west side of Tuck Inlet.

In summary, common corridor planning caused B.C. Hydro to add segments A-A'-B'-C, A-A'-C, F-G west and G-I to those being considered actively during the route location study.

4.3 Route Engineering Studies

Preliminary route engineering studies, conducted by B.C. Hydro, are concerned primarily with transmission line length, cost and security. Steep and rugged terrain, severe climatic conditions and long water crossings, for example, increase costs significantly. Natural hazards, such as avalanches, landslides, floods and erosion, threaten the security of the transmission line and must be avoided wherever possible. Construction costs and maintenance time and costs are significantly greater where access is poor. In general, construction and maintenance costs and environmental impacts increase proportionately with the length of a line.

4.4 Preliminary Project Cost Estimates

The estimated cost of the Rupert-Grassy Point transmission line is between 13 and 21 million dollars. Cost variations depend upon the voltage level and the route options selected. They are itemized in Figure 5.

Costs include engineering design, surveying, clearing, material, labor, and right of way acquisition (except through Lax Kw'alaams Indian Reserve #2). These costs estimates assume project completion in 1986. These estimates do not include the expense of terminating the new transmission line at Rupert Substation or within the LNG plant. Termination of a 287 kV supply at B.C. Hydro's Rupert Station would cost about $3,000,000.

FIGURE 5

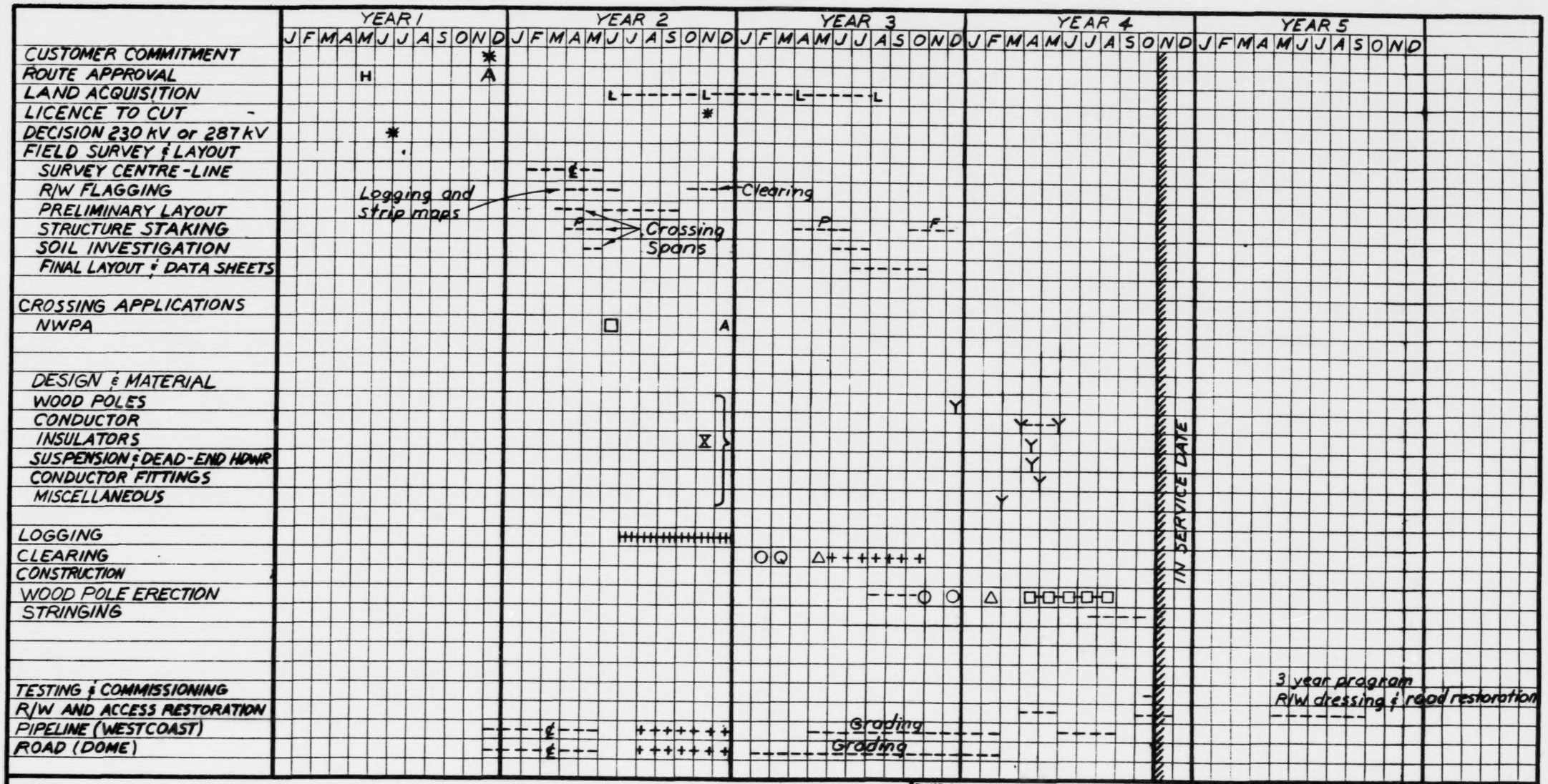
Preliminary Project Cost Guidelines And Route Segment Lengths

Route Segment	Seg.Length(km)	Cost Guidelines in $1,000 Units* 230 kV	287 kV
A-A'	6.3	5,220	6,347
A-B	2.3	475	596
A-A'-C	12.0	8,649	10,503
A'-B'	1.7	1,170	1,225
B-B'-C	10.7	2,723	3,301
B-D	5.7	5,000	5,828
B'-C	5.1	1,295	1,575
C-D	3.3	1,053	1,222
D-E	3.7	1,180	1,376
E-F	1.0	1,004	1,047
E-H	14.5	4,153	4,905
F-G (East)	8.0	2,543	2,963
F-G (West)	9.5	3,022	3,519
G-H	7.0	2,230	2,598
G-I	18.3	4,002	4,886
H-I	13.0	4,146	4,826

* These costs are to round number accuracy only; excess digits are due to machine tabulation. These cost guidelines include an allowance for corporate costs, and some inflation exclusive of interest charges during construction.

4.5 Project Schedule

The Rupert-Grassy Point transmission line can be completed by the proposed in-service date of October 31, 1986. The preliminary general schedule for this project assumes use of the common corridors, coordinated surveying, clearing and construction activities by the three companies, regulatory approval of the Western LNG Project by October 1983, and no extraordinary delays in logging and clearing of the rights of way. Figure 6 shows the preliminary project schedule for route A-B-C-D-E-F-G-I.



LEGEND:

	TARGET	ACTUAL
ASSIGNMENT APPROVED	*	⊛
ROUTE APPROVED	H	Ⓗ
ROUTE ACCEPTED-EXTERNAL	A	Ⓐ
PERMISSION TO ENTER-SURVEY	ES	Ⓔ
PERMISSION TO ENTER-CLEARING AND CONSTRUCTION	EC	Ⓔ
LAND ACQUISITION	-L-	⊏⊐

	TARGET	ACTUAL
PERIOD OF EFFORT	----	———
DRAWINGS ISSUED	□	■
BILL OF MATERIAL ISSUED	⧖	⧗
CONTRACT DOCUMENTS ISSUED	○	●
TESTING AND APPRAISAL	T- - -T	Ⓣ——Ⓣ
TENDERS	Q	●
CONTRACT AWARD	△	▲
DELIVERY DATE	Y	Ⓨ

	TARGET	ACTUAL
CENTRELINE SURVEY & PROFILE	--℄--	—℄—
STAKING P-PRELIMINARY, F-FINAL	----	~~~~
SOILS INVESTIGATION	--S--	-S-
LOGGING	++++++	++++++
CLEARING	++++	++++
CROSSING APPROVALS	C	Ⓒ
FOUNDATIONS	○○○○	●●●●
ERECTION	□□□□	■■■■
STRINGING	———	———

FUNCTIONAL CODE 7.03

				MICROFILMED
				ROUTE ENGINEERING
				DESIGN
				CONSTRUCTION
			DWB	PROJECT ENGINEER
				PROJECT MANAGER
				DATE 15 JUNE 83
3	2	1	0	REVISIONS

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
TRANSMISSION PROJECTS DIVISION

RUPERT - GRASSY POINT
230 OR 287 kV T/L
PRELIMINARY
ROUTE A-B-C-D-E-F-G-I
PROJECT GENERAL SCHEDULE

PARR NO. 811152 ASSIGN. NO. 481-044

SK-DWB-15-06-83 | FIGURE 6

4.6 Environmental Impact Assessment Studies

Environmental impact assessment studies for the Rupert-Grassy Point transmission line were conducted between September 1982 and January 1983. Findings are outlined here.

The environmental studies describe and assess the possible socio-economic and environmental consequences of building a transmission line along the technically feasible corridors. In addition, means to minimize potential adverse environmental impacts are recommended. These studies examine, for each segment, the effects of this project upon the terrain, water resources, vegetation, fish, wildlife, land use, agriculture, forestry, mining, visual impact, recreational use, and heritage resources. The segments are classified and mapped according to the assessment of potential impacts and of B.C. Hydro's ability to avoid or to mitigate adverse effects during the construction and operation of the transmission line. Recommendations for mitigation are made by the environmental study consultants based on their studies and their findings about the severity of potential impacts, discussions with B.C. Hydro personnel and knowledge of standard B.C. Hydro construction practices.

Two sets of assumptions were used during this environmental impact assessment. The first assumes the transmission line alone. The second assumes a common corridor containing the transmission

line and either or both the road and the natural gas pipeline together.

The major environmental constraints to transmission line construction are mapped on Figure 7, found in the rear pocket. The major specific findings of the environmental study are summarized below.

4.7 Route Description

This section describes the route options studied. The specific conclusions of the route engineering and environmental studies are summarized on a segment by segment basis. See Figure 2 in the rear pocket.

4.7.1 Segment A-A', Kaien Island

This segment lies between the Rupert Substation and Butze Rapids. The area is congested; therefore, double circuit steel structures would be necessary in order to allow for orderly future expansion of the local Prince Rupert area transmission system.

4.7.2 Segment A-B, Kloiya Bay

This route option begins at Rupert Substation and goes eastward across Kloiya Bay.

The terrain is generally easy. A standard wood pole crossing over Kloiya Bay would be adequate, unless Transport Canada requests more clearance under the provisions of the Navigable Waters Protection Act.

Due to the topography, a structure would be placed on a prominent 100 meter knoll at the mouth of Kloiya Bay. The structure and the right of way would be highly visible to boaters.

4.7.3 Segment A'-C, Morse Basin West

This segment begins near Butze Rapids and follows the west side of Morse Basin until it crosses Fern Passage at David Point.

This route option has easier access for construction and maintenance and better transmission line security than the route on the east side of Morse Basin.

Most environmental impacts can be avoided with careful route selection. A number of small bogs cover a large portion of Kaien

Island, including a large bog woodland complex north of Hospital Cove. The east slope of Mt. Oldfield and the north slope of Mt. Stewart are subject to occasional debris slides.

The most severe impact would occur at Seal Cove. An overhead transmission line and bridge across Fern Passage would disrupt the seaplane base operations and would obscure the view from the waterfront.

The City of Prince Rupert has tentative plans to build a pedestrian walk along the waterfront between Hays Creek and Seal Cove.

4.7.4 Segment A'-B', Butze Rapids

Beginning at point A', this segment traverses easy terrain to Butze Rapids. Then it spans Butze Rapids and intersects segment B-C at B'.

The crossing would be adjacent to the bridge. If a small island in the main channel can be used, then standard wood pole construction is likely. If not, steel structures would be required. This crossing would have to meet the requirements of the Navigable Waters Protection Act and Transport Canada's aviation standards for marking structures.

This route option would be used only if a bridge were constructed across Butze Rapids. The transmission line itself would create small incremental environmental impacts to those created by the road and bridge. The initial visual, marine, and aviation traffic impacts would be caused by the road and bridge. Careful detailed route selection should avoid land use conflicts on the foreshore.

4.7.5 Segment B-B'-C, Morse Basin East

This segment begins by crossing Denise Inlet and continues along the east shore of Morse Basin. The route goes past Butze Rapids and Fern Passage, but avoids the Indian reserve near Shawatlan Lake. The crossing of Shawatlan River is below the water intake, although it is within the watershed reserve.

The line must be located on the flat areas away from the toe of the slope, where evidence of mud slides exists. Construction along this segment would not be difficult. The lack of road access would be a problem without the industrial road. Standard wood pole structures would be used unless Transport Canada requests additional clearance across Denise Inlet.

Within this segment, the major environmental concern is visual. The cleared right of way on the exposed slopes near the "elbow" of Morse Basin would be visible from the proposed

residential area south of Butze Rapids, and from boats in Morse Basin. The development of new access may affect future recreational use patterns.

4.7.6 Segment B-D, Denise Inlet - Woodworth Lake

This segment begins at Kloiya Bay and proceeds in a northeastern direction along the west side of Denise Inlet, and westward along Woodworth Lake to a ridge overlooking Prince Rupert Harbor.

This segment is located in steep terrain and is subject to mud slides. Extended periods of fog would make line repair difficult and time consuming.

The route enters the Prince Rupert watershed reserve in the narrow pass between Mahlon and Bannock lakes. The usual health precautions would have to be observed during construction, operation and maintenance. Construction activities could increase sediment in Woodworth Lake. Assuming sufficient environmental precautions within the watershed, no major problems are anticipated.

The tidal marsh at the head of Denise Inlet would not be used for barge or equipment landings. Sensitive bog woodland vegetation in the vicinity of Mahlon and Bannock lakes should be

avoided.

The Denise Inlet-Woodworth Lake segment would include the transmission line and the natural gas pipeline. The main environmental concern is any effect activities within the watershed would have on water quality, and possible effects to sensitive vegetation between Denise Creek and the Shawatlan River. Common access roads should be used. Helicopter construction may be necessary in steep terrain in order to limit the need for spur access roads.

4.7.7 Segment B'-C, Butze-Shawatlan

This segment is the same as the northern half of segment B-C, except that a bridge and a road are assumed.

4.7.8 Segment C-D, Shawatlan Lake

Segment C-D traverses the Prince Rupert watershed reserve. The route is level and dotted with muskeg and swamp.

No significant impacts are expected if the transmission line avoids the shoreline and marsh nesting cover of Shawatlan Lake. Significant visual impacts can be avoided by running the line east of the exposed slopes leading to Prince Rupert Harbour.

4.7.9 Segment D-E, Laurier Cove South

In the vicinity of Silver Creek the terrain is steep and the valley is narrow. Construction of a secure line along this segment would be difficult but the road would be an asset.

4.7.10 Segment E-F, Laurier Cove North

This short segment is one of the most difficult. Steep mountain slopes are unstable on both sides of the cove.

The tidal marsh would be avoided. Silver Creek is a salmon spawning stream. Siltation associated with construction should be avoided. Laurier Cove is visible from the sea and from Prince Rupert 8 km to the south.

4.7.11 Segment E-H, Silver Creek - Work Channel

This segment is unacceptable for transmission line construction. The Silver Creek valley is narrow and steep. Mud slide potential is high. The area along Work Channel is very steep, incised with many gulleys, and subject to mud slides. The bench above Work Channel is up to 1700 m high and is very exposed to winds. Security would be unacceptably low.

4.7.12 Segment F-G East, Tuck Inlet East

This segment follows the east side of Tuck Inlet.

Location of the line in this section would be critical. The primary concern is the limited space available for the road, pipeline and transmission line. However, cooperative common corridor planning should ameliorate most difficulties.

The timber growth is heavy. Clearing and road access would be difficult and costly. The fragile bog vegetation areas should be avoided.

4.7.13 Segment F-G West, Tuck Inlet West

This segment crosses Tuck Narrows and runs north along the west shore of Tuck Inlet. The crossing of Tuck Narrows would use standard wood poles, unless Transport Canada requested additional clearance.

A transmission line along this section would have to be located close to the shore because of mud slides along the steep slopes inland. Geotechnical constraints would present construction difficulties where a high concentration of debris slides and torrents exist. Steep slopes along the northern half of this segment are subject to debris slides, which would be

difficult to avoid. In addition, valuable forest resources extend from Tuck Point northward to the head of the inlet. Crossing Tuck Narrows from Laurier Cove with an overhead line would require highly visible aviation markings. A heritage site at Tuck Point may be affected.

4.7.14 Segment G-H, Tuck Inlet-Work Channel

This segment goes northeast from the head of Tuck Inlet to Work Channel. It would traverse steep terrain and some high elevations. The mud slide potential is high. Steep slopes and fragile bogs present problems at the pass between Little Georgetown Creek and Work Channel. A transmission line along the high elevations close to Work Channel would have to be designed for heavy ice and wind loading.

There have been logging activities near Tuck Inlet in recent years. Potential forest production would be lost, if this segment is used.

A transmission line through the pass between Little Georgetown Creek and Work Channel would be visible against the sky. High altitude right of way clearing would be visible for 10 km or more to boaters using Work Channel.

4.7.15 Segment G-I, Georgetown-Port Simpson

This segment enters Lax Kw'alaams Indian Reserve #2 and goes along the east side of Georgetown Lake. Then, it runs north between Mount Griffin and Mount Ben to the LNG plant site. Access is good. The terrain and elevation are amenable to transmission line construction. Line security would be acceptable.

No significant environmental impacts are expected within this segment if certain sensitive habitats are avoided. Damage to Stumaun Creek and to Lahon Creek can be minimized by locating transmission line access routes well away from the creek channels. Where necessary, bridges rather than culverts would be installed on the construction access road.

Forest productivity is good along this segment although the majority of the forest has been logged and now supports young forest stands. A transmission line here would cause loss of productive forest land in the Georgetown Lake and the Mount Griffin areas.

Construction activity near Neaxtoalk Lake should be planned carefully in order to protect wildlife, recreation and visual resources there. However, the impact of the transmission line itself will be a small part of the project's overall

environmental impact near the LNG plant site. Construction of the transmission line would be coordinated with the construction of the plant's water supply, the pipeline and and the road in this area.

Use of this segment would require a right of way agreement between B.C. Hydro and the Lax Kw'alaams Band.

4.7.16 Segment H-I, Work Channel-Grassy Point

This segment runs along the west side of Work Channel. No access exists. The southern part is located at a high exposed elevation. The terrain is steep and subject to mud flows. Many swamps and areas of muskeg are present at the north end. Construction would be difficult.

5 CONCLUSIONS

The Tsimpsean Peninsula is difficult territory for transmission line construction and operation. Nevertheless, several routes, including new opportunities presented during the common corridor planning process, are possible between the Rupert Substation at the south end of Morse Basin and the Western LNG Project site. Based upon the system planning, route engineering and environmental impact assessment studies and upon on-going corridor planning discussions between Dome, Westcoast and B.C. Hydro and with government agencies and interest groups, the following observations are made.

The route recommended originally by B.C. Hydro is A-B-C-D-E-F-G-H-I. It avoids a Morse Basin crossing and does not cross the Indian reserve. This route would be 49 km long and would cost approximately $15,354,000 for a 230 kV line and about $17,929,000 for a 287 kV line.

However, this transmission line would not be built in isolation. Dome plans to construct an industrial road along A'-B'-C-D-E-F-G-I. The natural gas pipeline will enter the area near the eastern end of Denise Inlet and will proceed past Woodworth Lake to node D and then along D-E-F-G-I. If various technical, environmental and administrative concerns can be resolved, then a common corridor for the road, transmission line and the pipeline should reduce the combined cost and environmental impact of these three facilities.

Since the preferred industrial road route includes a bridge at Butze Rapids, a transmission route using this crossing, A-A'-B'-C, is a feasible alternative to a route A-B-C around Morse Basin via Kloiya Bay. In addition, route G-I through the Indian Reserve was reconsidered because the road and the natural pipeline will cross it.

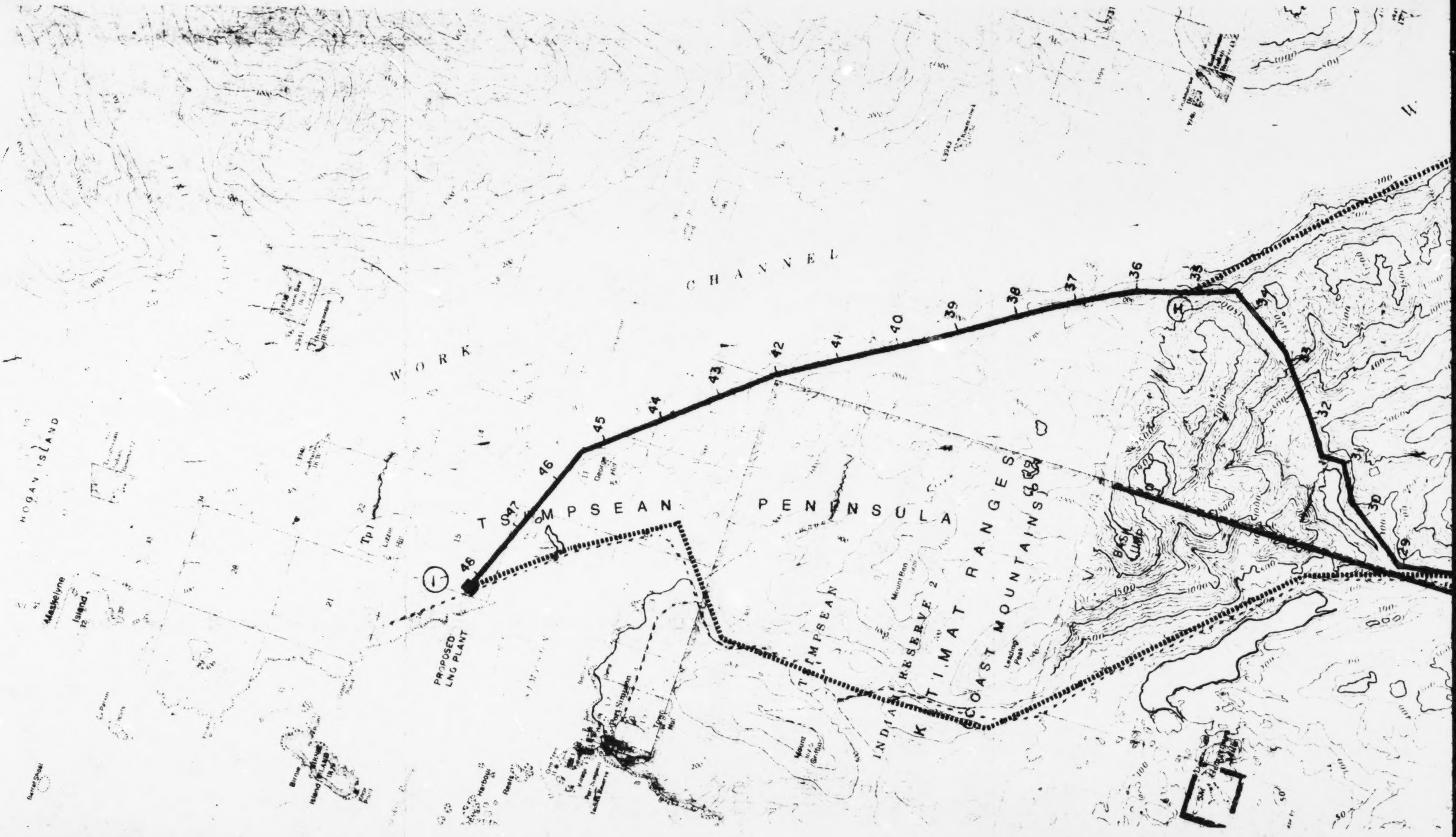
Route G-I is more direct, crosses easier terrain, and would be less costly to construct than route G-H-I. Also, operation and maintenance of G-I would be easier and less costly than G-H-I because of access offered by the road. The combined impact on the Tsimpsean Peninsula should be reduced also.

Dome is currently negotiating a comprehensive agreement with the Indian band; included in this agreement will be provision for a right of way for the transmission line. If Dome is successful in negotiating a right of way agreement satisfactory to B.C. Hydro, then G-I is clearly preferable to G-H-I.

In general, the most advantageous transmission route is one that parallels the road and pipeline as much as possible. Nevertheless, after weighing the relative merits of routes A-B-C and A-A'-B'-C, B.C. Hydro prefers to go around Morse Basin via Kloiya Bay rather than cross adjacent to the bridge at Butze Rapids. Route A-A'-B'-C would cost about one-third more, would be technically more difficult, would require double circuit steel structures along Hospital Cove and Galloway Rapids, and would preempt land needed for future transmission

line rights of way on Kaien Island. Route A-B-C would use wood poles and could be completed in a shorter time, although the visual impact may be important.

Therefore, all things considered, B.C. Hydro recommends use of route A-B-C-D-E-F-G-I, assuming that a satisfactory right of way agreement through the Indian reserve is negotiated. This route would be 47.3 km long and would cost approximately $12,980,000 for a 230 kV line and about $15,391,000 for a 287 kV line. But, if Dome decides that a crossing at Butze Rapids is more appropriate, the Rupert-Grassy Point transmission line can be built via route A-A'-B'-C-D-E-F-G-I. This route would be 47.4 km long and would cost approximately $17,467,000 for a 230 kV line and about $20,641,000 for a 287 kV line.


CHANNEL
WORK
PENINSULA
TSIMPSEAN
PROPOSED LNG PLANT
Mastelyne Island
Tp 1
Lizzie Hill
George Hill
Port Simpson
Mount Ker
Mount Gaffney
Mount Ron
Leading Peak
Basil Hump
INDIAN RESERVE 2
KITIMAT RANGES
COAST MOUNTAINS
33
34
35
36
37
38
39
40
41
42
43
44
45
46
32
31
30
29
1
2
1500
1000
500
100
50

W

E

M

WATERSHED

RESERVE

SHARP PEAK

MOUNT HORSE

PRINCE RUPERT

A

A'

B

B'

C

C'

D

D'

E

E'

F

F'

G

G'

H

H'

36

33

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7

251

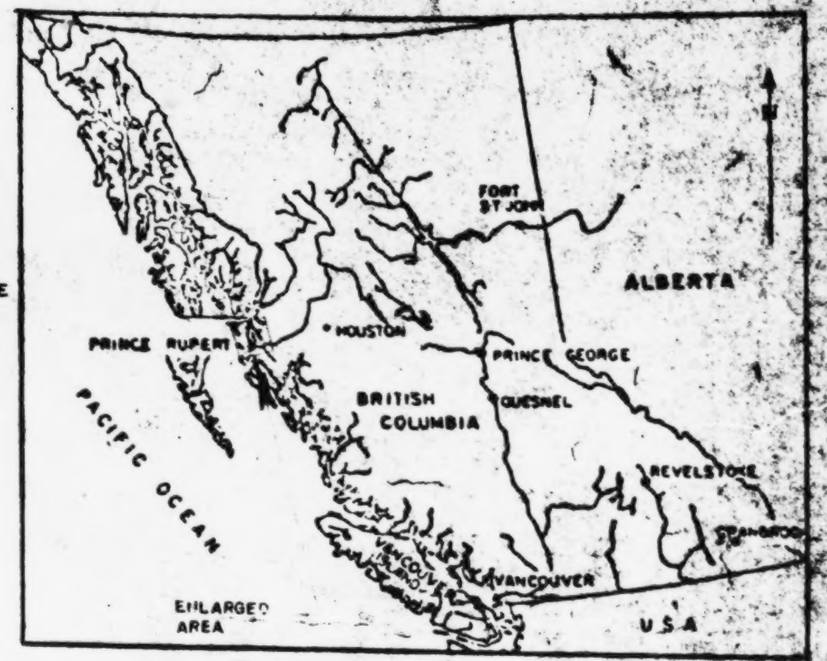
INITIAL PROPOSED ROUTE

PROPOSED ALTERNATE ROUTE

WATERSHED RESERVE BOUNDARY

PROPOSED ROAD

NOTE CONTOURS IN FEET

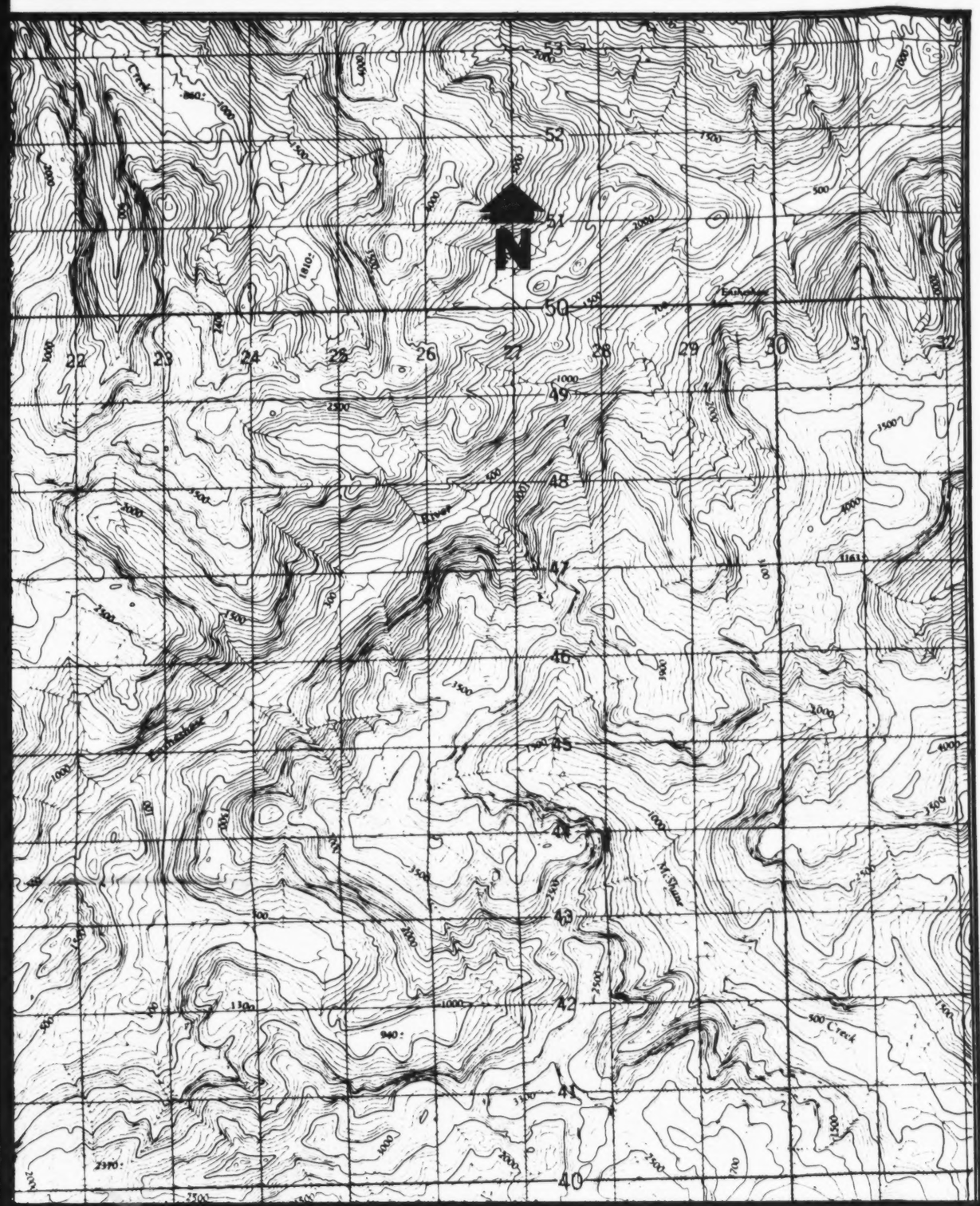


KEY PLAN

P	No	REVISIONS	DRAWN	CHKD	ENGD	APPD				DATE
	3	Four rejected routes deleted and title revised	BWJ	WS						3 P-83
	2	Butze Rapids alternate added	WS							21 DEC 82
	1	Alternate Route 3 revised	WS							7 DEC 82

DESIGNED	SUBMITTED	SEAL	BRITISH COLUMBIA HYDRO AND POWER AUTHORITY TRANSMISSION DESIGN DEPARTMENT
DRAWN	INSPECTED		RUPERT — GRASSY POINT 287 kV T/L ROUTE STUDY PLAN FIG. 2
CHECKED DRAFTING	INSPECTED		
CHECKED DESIGN	INSPECTED		
APPROVED	DATE 25-V-81	SCALE	DWG No 3 TC-T07 X44 M 3

Flewin Point
Picnic Point
Birnie Island
Glassy Point
Knox Point
LIZZIE HILL
V, T
Inskip Passage
PORT
Harbour Reefs
SIMPSON
R, WR, T, W
Trail Bay
Grace Point
Gordon Point
Dodd
One Tree Islet
Village Island
Bath Point
Port Simpson
R, WR, T, V, I
F, WR
CUNNINHAM PASSAGE
FINLAYSON ISLAND
INDIAN RESERVE
Sarah Point
Duncan Point
Fortune Pt
Centre Rock
Pender Rock
Dodd Rock
Sparrowhawk Rock
Flat Top Islands
Otter Anch
Otter Cove
Mist Island
Point Harbour
MOUNT GRIEVE
MOUNT BEN
GEORGE HILL
BROWN HILL
V, T
T, V
Georgetown
CHATHAM SOUND
WORK CHANNEL
Work Channel
Lama Point
Worsfold Bay
MOUNT MITCHELL
WORK CHANNEL
04 07 08 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
59 51 50 48 47 46 44 43 42 41



PRINCE RUPERT - PORT SIMPSON TRANSMISSION LINE

FIGURE 7

ENVIRONMENTAL CONSTRAINTS

VERY SEVERE

SEVERE

Type of Constraint

T	**TERRAIN**
V	**VEGETATION**
F	**FORESTRY**
WR	**WATER RESOURCES**
FI	**FISH**

Georgetown Lake – Port Simpson

Silver Creek

Tuck Inlet East

T, V

T, WR

T, WR

T, WR

INDIAN RESERVE No. 1

T S I M P S E

SOUND

CHATHAM SOUND

NORTH PASSAGE

SOUTH PASSAGE

BIG BAY

GEORGETOWN LAKE

TUCK INLET

WORK CHANNEL

PENINSULA

BASIL LUMP

SHATTOCK HILL

SHARP PEAK

MOUNT GRIFFIN

MOUNT BEN

Duncan Point

Fortune Pt

Dodd Rock

Centre Rock

Pender Rock

Sparrowhawk Rock

Flat Top Islands

Otter Anch

Saturn Rock

Mist Island

Pearl Harbour

Cultivation Pt

Burnt Cliff I

Bellatti Pt

South I

Haycock I

Whitecliff

Shattock Pt

Simpson Pt

East Base Pt

Salmon Right

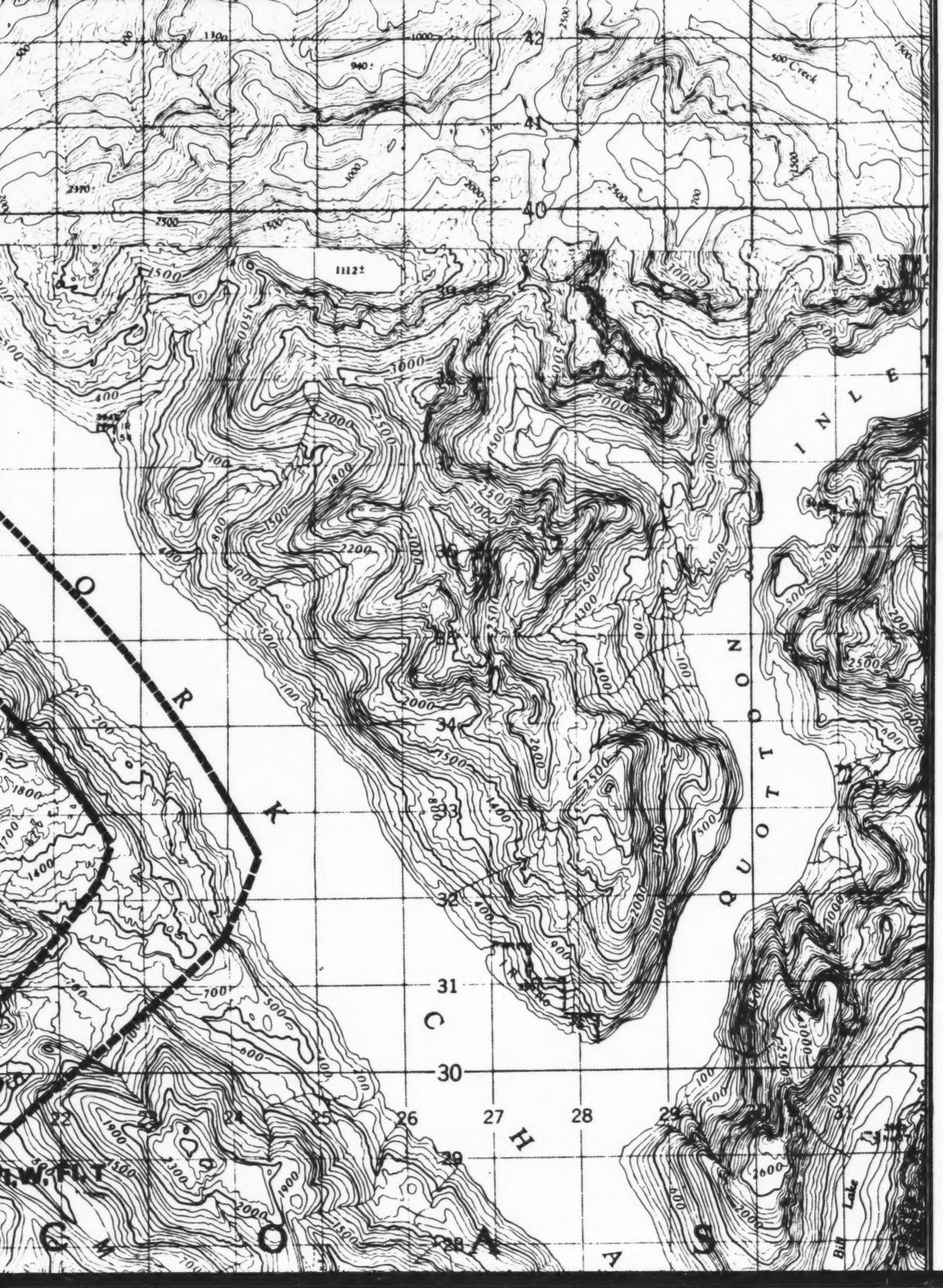
West Base Pt

Reade Pt

Tremble Pt

Tree Bluff

03 04 05 06 07 08 09 10 11 12 13 18 21 22 29 30 31 32 33 34 35 36 39 40 41 42 43



T TERRAIN

V VEGETATION

F FORESTRY

WR WATER RESOURCES

FI FISH

W WILDLIFE

L LAND USE

VI VISUAL ANALYSIS

R RECREATION

H HERITAGE RESOURCES

Shawatlan Lake

Denise Inlet-W

Morse Basin East

Morse Basin West

Kloiya Bay

PRINCE RUPERT

HARBOUR

PRINCE RUPERT

INDIAN RESERVE No 2

INDIAN RESERVE No 2

DUNCAN BAY

BAY

PROSPECT HILD

Metlakatla

VENN PASSAGE

TUGWELL I

03 METLAKATLA 05

06 KEEN HILLS

DIXON ENTRANCE

CHATHAM SOUND

Norwegian Village

MT COMBLAIN

MORAINE

HAYS

GOVERNMENT RESERVE

NATIONAL

WAINWRIGHT BASIN

DENISE INLE

WWT WR E

WWRTW

WRL

FI

Tsook Lake

Mission Pt

Observation Pt

Devastation I

Knight I

Straits Pt

Henry Pt

Little Cridge I

Cridge

Snider Ii

Martin I

Boundary Cove

Cripple Cove

Grindstone I

Grindstone Pt

Tobey Pt

Dodge I

Dodge Cove

Elizabeth Pt

Fairview Pt

Casey Cove

Charles Pt

Casey Pt

Emmerson Pt

Philips Pt

Frederick Pt

Miller Pt

Pillsbury Pt

Grain Elevator

CN Dock

Philips Cove

Pillsbury Cove

Melville Arm

Russell Arm

Detention I

Douglas Pt

Bacon Cove

Vigilant I

Hays Cove

Cow Bay

Gribbell Islet

Isabel Ii

Auriol Pt

Ritchie I

Verney I

Wilgaspshi I

Garden I

White I

Du Vernet Pt

Ryan Pt

Schramm Pt

McNichol

Mahaffy

Kloiya Bay

1991

1992

1993

1995

1996

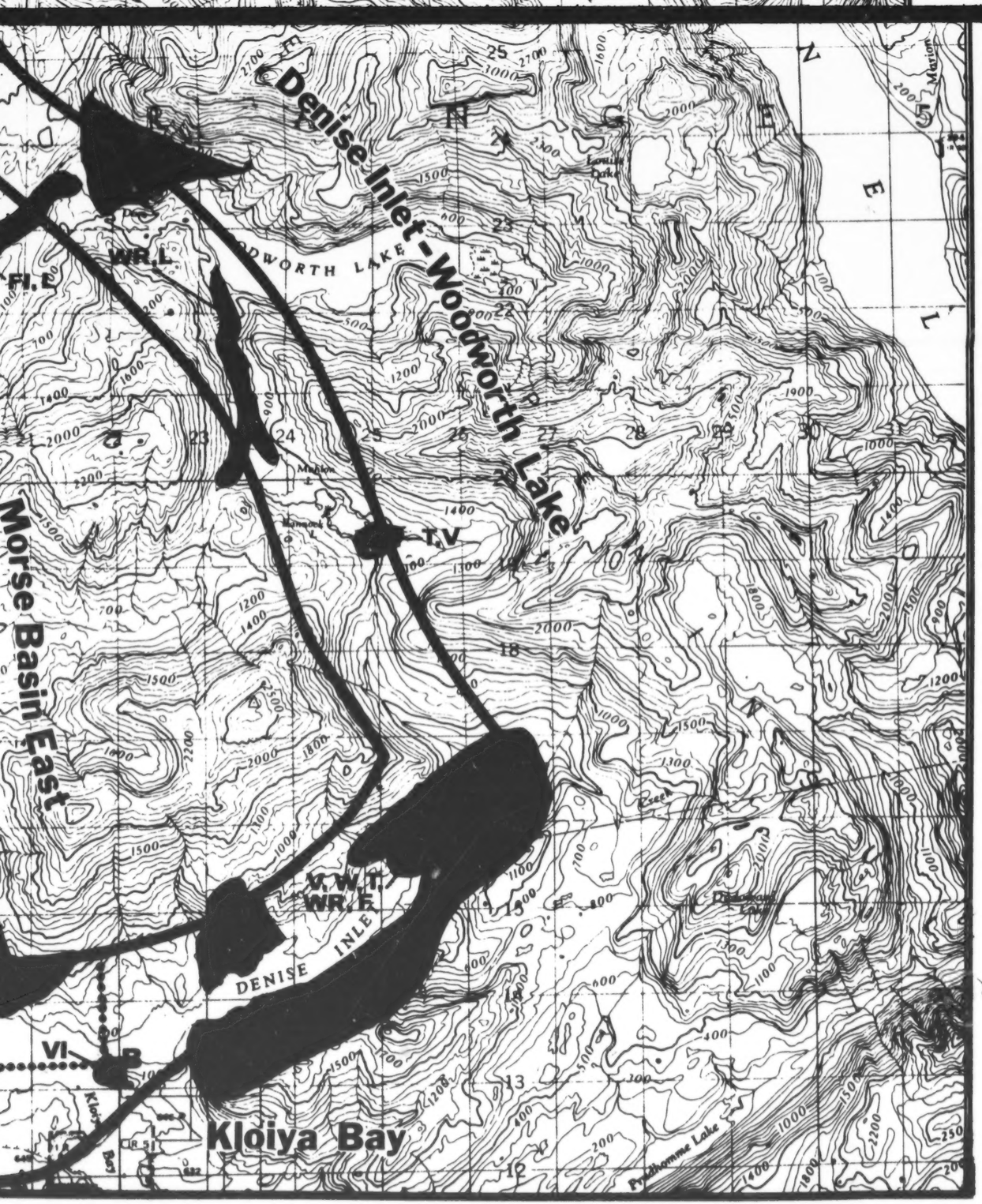
1998

1999

2000

2004

2049



corridor boundary

segment boundary

corridor no longer considered feasible

A● engineering nodes

1 0 1 2 3 4

kilometres

B.C. Hydro

Dome Petroleum Limited

tera ENVIRONMENTAL CONSULTANTS LTD.